

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 26 January 2001 (26.01.01)	Applicant's or agent's file reference 51779/002
International application No. PCT/GB00/02208	Priority date (day/month/year) 07 June 1999 (07.06.99)
International filing date (day/month/year) 07 June 2000 (07.06.00)	
Applicant HALL, David, John	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
22 December 2000 (22.12.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Juan Cruz
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PCT COOPERATION TREATY

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From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

BOULT WADE TENNANT
Verulam Gardens
70 Gray's Inn Road
London WC1X 8BT
ROYAUME-UNI

Date of mailing (day/month/year) 29 October 2001 (29.10.01)	To: BOULT WADE TENNANT Verulam Gardens 70 Gray's Inn Road London WC1X 8BT ROYAUME-UNI
Applicant's or agent's file reference 51779/002	
International application No. PCT/GB00/02208	IMPORTANT NOTIFICATION International filing date (day/month/year) 07 June 2000 (07.06.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address CINPRES LIMITED	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address CINPRES GAS INJECTION LIMITED RECEIVED 4 5 NOV 2001 BOULT WADE TENNANT	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Ki-Nam HA Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 51779/002	<div style="display: flex; justify-content: space-between;"> <div>FOR FURTHER ACTION</div> <div>See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)</div> </div>	
International application No. PCT/GB00/02208	International filing date (day/month/year) 07/06/2000	Priority date (day/month/year) 07/06/1999
International Patent Classification (IPC) or national classification and IPC B29C45/17		
Applicant CINPRES LIMITED		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 22/12/2000	Date of completion of this report 12.02.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Kujat, C Telephone No. +49 89 2399 2360 <div style="text-align: right;">  </div>

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/02208

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:

Description, pages:

1-12 as originally filed

Claims, No.:

1-12 as originally filed

Drawings, sheets:

1/7-7/7 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/02208

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-12
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-12
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/02208

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 1). The present invention fulfills the requirements of Article 33(2-3) PCT, because the subject-matters of independent claims 1 and 12 are novel and inventive.
 - 1.1 The most relevant prior art is disclosed in D1 (EP-A-0644821), which has been cited in the description.
 - 1.2 The problem to be solved by the present invention may be regarded as providing an alternative solution for recovery of the pressurized gas.
 - 1.3 The solution is according to independent claim 1: In particular, by allowing combined retraction of inner valve member 46 and sleeve member 31 inside body member 30 from an extended to a retracted position in order to create a passage inside body member 30 [between sleeve member 31 and body member 30]. All the while body member 30 remains mounted in the mould.
 - 1.4 None of the documents cited in the S. R. discloses or renders obvious two coaxially-spaced independently- and jointly-movable members (inner valve member 46 and sleeve member 31) inside a body member. In D1, the entire nozzle is retracted from the injection mould in order to create a passage between body member and injection mould.
- 2). Claims 2 to 11 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3). Independent claim 12 is directed to an (injection moulding) apparatus comprising the novel and inventive nozzle as defined in claims 1 to 11.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/02208

4). Remark:

Although independent claims 1 and 12 relate to apparatuses, the two-part form, with delimitation over D1, is not required because the invention is a complex system of functionally interrelated parts, the inventive step concerning changes in several of these and in their inter-relationships (PCT Gazette, section IV, chapter III-2.3).

Re Item VII

Certain defects in the international application

5. The features of the claims 1 to 12 are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) 51779/002

Box No. I TITLE OF INVENTION

GAS NOZZLE AND APPARATUS FOR GAS-ASSISTED INJECTION MOULDING

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

CINPRES LIMITED
NINIAN PARK
NINIAN WAY
TAMWORTH
STAFFORDSHIRE B77 5ES
UNITED KINGDOM

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (that is, country) of nationality:
UNITED KINGDOM

State (that is, country) of residence:
UNITED KINGDOM

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

HALL, DAVID JOHN
19 LABURNUM AVENUE
TAMWORTH
STAFFORDSHIRE B79 8QR
UNITED KINGDOM

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:
UNITED KINGDOM

State (that is, country) of residence:
UNITED KINGDOM

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BOULT WADE TENNANT
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☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 7th June 1999	9913186.4	United Kingdom		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA /

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 3

description (excluding sequence listing part) : 12

claims : 3

abstract : 1

drawings : 7

sequence listing part of description : _____

Total number of sheets : 26

This international application is accompanied by the item(s) marked below:

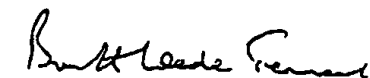
1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney, reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other (specify):

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).



BOULT WADE TENNANT

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

ENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 51779/002	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 02208	International filing date (day/month/year) 07/06/2000	(Earliest) Priority Date (day/month/year) 07/06/1999
Applicant CINPRES LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☒ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

3

☐ None of the figures.

(19) World Intellectual Property Organization
International Bureau



INTERNATIONAL PATENT COOPERATION TREATY (PCT)

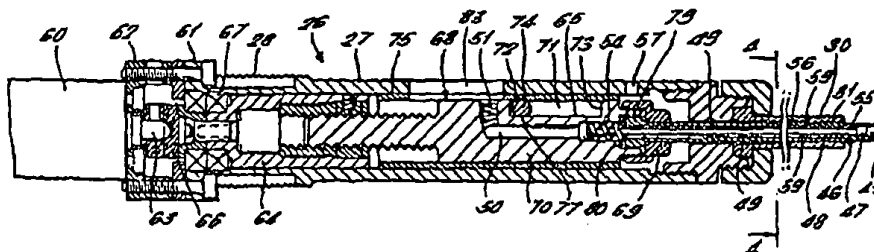
(43) International Publication Date
14 December 2000 (14.12.2000)

PCT

(10) International Publication Number
WO 00/74918 A1

- (51) International Patent Classification⁷: B29C 45/17
- (21) International Application Number: PCT/GB00/02208
- (22) International Filing Date: 7 June 2000 (07.06.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
9913186.4 7 June 1999 (07.06.1999) GB
- (71) Applicant (for all designated States except US): CIN-PRES LIMITED [GB/GB]; Ninian Park, Ninian Way, Tamworth, Staffordshire B77 5ES (GB).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): HALL, David, John [GB/GB]; 19 Laburnum Avenue, Tamworth, Staffordshire B79 8QR (GB).
- (74) Agent: BOULT WADE TENNANT; Verulam Gardens, 70 Gray's Inn Road, London WC1X 8BT (GB).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:
— With international search report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: GAS NOZZLE AND APPARATUS FOR GAS-ASSISTED INJECTION MOULDING



WO 00/74918 A1

(57) Abstract: A nozzle (26) for supplying/relieving pressurized gas in gas assisted injection moulding of plastics material, comprises a body member (27) adapted to be mounted in a mould (9) having a mould cavity (13), a portion of the body member or an extension (30) thereof extending into an opening (44) in the mould which at least communicates with the mould cavity. A sleeve member (31) is mounted for sliding movement in a bore in the extending portion of the body member between an extended position in which one end of the sleeve projects beyond the extending portion of the body member into the mould cavity, and a retracted position, said one end of the sleeve defining a valve port (45) for an inner valve member (46). Attachment means supply pressurized gas to the inside of the sleeve whereby the inner valve member is movable into a valve port open position by the pressurized gas. An electric motor (60) preferably moves the sleeve between its extended and its retracted positions. A gap (56) is provided between the adjacent wall of the sleeve and the extending portion of the body member, the gap being closed to the mould cavity when the sleeve member is extended and open to the mould cavity when the sleeve member is retracted, whereby in the retracted position of the sleeve, the pressurized gas within the mould cavity can vent to atmosphere. There is also provided an apparatus for gas-assisted injection moulding including the nozzle (26).

GAS NOZZLE AND APPARATUS FOR GAS-ASSISTED INJECTION
MOULDING

5 This invention relates to a gas nozzle for gas-assisted injection moulding. The invention also relates to an apparatus for gas-assisted injection moulding.

10 In gas-assisted injection moulding of a plastic article, it is known from EP-A-0644821 to provide a gas nozzle separate from the plastics injection nozzle. The gas nozzle is mounted in an opening within one of the mould parts for injecting pressurized gas directly into the plastics material within the mould cavity, whereby the gas creates a gas
15 containing cavity in the plastics material, and for thereafter relieving the gas pressure within the gas containing cavity before the mould is opened. The gas supply/pressure relieving means comprises a retractable valve member connected to the piston of a
20 hydraulic or pneumatic cylinder. In its forward position, the valve member projects into the mould cavity and pressurized gas is injected through a bore in the valve member. In its withdrawn position, gas is vented through the open valve port provided by the opening in which the gas nozzle is mounted, the gas
25 passing to atmosphere between the valve member and the wall of the mould part. The bore of the valve member has a shut-off control valve comprising an axially movable member which is opened by the pressure of the gas to be injected and is closed by a spring. In its
30 open position, the inner valve member projects further into the mould cavity than the outer valve member.

According to the invention there is provided a nozzle for supplying/relieving pressurized gas in gas assisted injection moulding of plastics material, the nozzle comprising:

5 a body member adapted to be mounted in a mould having a mould cavity, a portion of the body member or an extension thereof extending into an opening in the mould which at least communicates with the mould cavity;

10 a sleeve member mounted for sliding movement in a bore in the extending portion of the body member between an extended position in which one end of the sleeve projects beyond the extending portion of the body member into the mould cavity, and a retracted position;

15 said one end of the sleeve defining a valve port for an inner valve member axially movable within the sleeve for opening and closing the valve port,

20 attachment means for supplying pressurized gas to the inside of the sleeve whereby the inner valve member is movable into a valve port open position by the pressurized gas;

 means for moving the inner valve member into a valve port closed position;

25 means for moving the sleeve between its extended and its retracted positions, and

30 a gap between the adjacent wall of the sleeve and the extending portion of the body member, which gap is closed to the mould cavity when the sleeve member is extended and open to the mould cavity when the sleeve member is retracted, whereby in the retracted position of the sleeve, the pressurized gas within the mould cavity can vent to atmosphere.

35 Preferably the means for moving the sleeve between its extended and retracted positions is a reversible electric motor, the sleeve being connected to the motor by means which enable the sleeve to move

linearly. When the sleeve reaches its extended position, the motor preferably enters a stall mode.

With the sleeve in its extended position, pressure on the sleeve is preferably isolated from the motor and its gear box.

Preferably the connection means between the sleeve and the motor is a nut and spindle in driving relation, the nut being driven by the motor and the spindle being connected to the sleeve.

The body member preferably has an external thread for mounting the nozzle in a mould part or a bracket fixed thereto. In another embodiment, the nozzle is bolted to a mould part.

Preferably the wall of the sleeve is tapered inwardly from the outer end of the sleeve to define a lead-in to the valve seat of the valve port.

It is also preferred that the means for moving the inner valve member into a valve port closed position is a spring.

Preferably the inner valve member is a sliding fit within the sleeve, and has at least one flat extending longitudinally of the valve member to create a passage for pressurized gas through the sleeve when the inner valve member is extended by the pressure of the gas.

The outer end of the sleeve is preferably of reduced external dimension relative to the internal dimension of the extending portion of the body member, the body member having at least one groove extending longitudinally from a position at one end where it can communicate with the reduced end portion of the sleeve when the sleeve is in its retracted position, but is precluded from said communication when the sleeve is in its extended position, to an open position at its other end where it communicates directly or indirectly with the atmosphere.

The invention also provides an apparatus for gas-

assisted injection moulding including a nozzle as defined above.

By way of example, specific embodiments will be described with reference to the accompanying drawings in which:-

Figure 1 shows an injection moulding machine having a nozzle for supplying/relieving pressurized gas into the plastics material within the mould cavity;

Figure 2 is a perspective view of the nozzle for supplying/relieving the pressurized gas to the mould cavity;

Figure 3 is a longitudinal section of the nozzle of Figure 1, with the electric motor omitted;

Figure 4 is a section along line 4-4 in Figure 3;

Figures 5 to 8 illustrate different stages in the injection moulding process; and

Figure 9 shows an alternative arrangement for mounting the nozzle in the mould.

This example concerns an apparatus for producing injection mouldings of plastics material which is based on the apparatus illustrated in Figure 1 of British Patent Specification No. 2202181. Also in general terms, the process of injection moulding is the same as described in that prior specification.

More particularly, a mould 9 of an injection moulding machine has upper and lower parts 11, 12 defining a mould cavity 13 of complex design and incorporating a rib 16. The mould parts 11, 12 are mounted between a fixed upper platen 10 and a lower platen 14 movable by a hydraulic ram 15. Also, in this embodiment, within the upper mould part 11 is a hot runner manifold 17 leading to a desired point of entry or opening 43 to the mould cavity 13.

A screw ram 18 is provided for introducing molten thermoplastic material 19 through a nozzle assembly 20 to the hot runner manifold 17 and hence through the

opening 43 in the mould cavity 13. The nozzle assembly is provided with a shut-off slide valve 21 activated by a bell-crank lever 22 and a link 23 connected to a hydraulic cylinder 24. The valve 21 is shown in its closed position at the end of that part of the moulding cycle which includes the introduction of the plastics material. The closed valve prevents any back flow of plastics material to the barrel of the screw ram, which may then be refilled with plastics material in preparation for the next moulding cycle.

A gas supply/relieving nozzle 26 provided for introducing pressurized gas to create a gas containing cavity 25 in the plastics material 19 has its downstream end located at a separate opening 44 in the mould cavity.

The nozzle 26 is mounted in a counterbore 29 in the lower part 12 of the mould, which is aligned with the opening 44. The nozzle 26 comprises a body member 27 having, in this embodiment, an external thread 28 for attachment of the nozzle by a nut 81 to a bracket 76 bolted to the lower part 12 of the mould. The nozzle thereby projects through the lower part 12 and a cylindrical extension member 30 extends from the inner end of the body member to the opening 44. The extension member 30 acts as a housing for a sleeve 31 through which pressurized gas is supplied to the mould cavity to create the gas filled cavity 25 in the plastics material 19.

The sleeve 31 is movable between an extended position in which the outer end adjacent the mould cavity 13 extends beyond the extension member 30 into the mould cavity (Figure 5) and a retracted position in which the outer end of the sleeve is withdrawn into the extension member (Figure 8). The outer end of the sleeve defines a valve port 45 having a valve seat 52

for an inner valve member 46 which is axially movable within the sleeve for opening and closing the valve port. A valve head 47 engages the valve seat 52 when the valve member is withdrawn into the sleeve, the
5 wall of the sleeve being tapered inwardly from the outer end of the sleeve to provide a lead-in to facilitate location of the valve head on the valve seat.

The valve stem 48 has opposed flats 59 extending
10 along the length of the stem defining gas passages 49 through the sleeve which, at their upstream ends, communicate via a sealed connection with a longitudinal bore 50 and upstream thereof a radial bore 51 within the body member of the nozzle. The
15 radial bore 51 is threaded for screw connection to a connector 78 on one end of a gas feed pipe 53, and a spring 54 located in an enlarged portion of bore 50 is provided for withdrawing the valve member 46. To facilitate the mounting of nozzle 26 in counterbore 29
20 in the lower mould part 12, a channel 32 is provided extending longitudinally of the body member (Figure 2), whereby the feed pipe 53 can be compressed into the channel after it is connected to the nozzle by screwing the connector 78 into bore 51. There is also
25 provided a slot 83 in the nozzle body member 27 to allow for movement of the feed pipe 53 and the connector 78 longitudinally of the nozzle during extension and retraction of the sleeve 31. Pressurized gas, e.g. nitrogen, is supplied to the feed pipe 53
30 from a chamber 35 by a piston and cylinder 33, 34, via a solenoid operated valve 36 which has a facility to vent. The chamber 35 is also connected to a gas supply (not shown) via a non-return valve 37 and a pressure regulator valve 38. With the sleeve 35
35 extended and valve 36 open to supply gas to the nozzle, pressurized gas from the chamber 35 will flow through feed pipe 53 into the bores 51, 50 and the

passages 49. The gas pressure will overcome the spring 54, thereby lifting the valve head 47 and injecting gas into the plastics within the mould cavity (Figure 7). When the gas pressure behind the valve head 47 declines by opening valve 36 to vent, the inner valve member will be withdrawn by the spring into its valve port closed position.

For subsequent venting of the gas from the mould cavity, the outer end of the sleeve 31 has an external rebate 55 around its periphery which communicates, in the retracted position of the sleeve, with an annular gap 56 extending longitudinally between the sleeve and the extension member 30 to an open position in the body member 27 of the nozzle. The gas can thereby escape through hole 57 in the body member, along a groove 58 in the external surface of the body member, the groove extending to the threaded end of the body member, and thereby to atmosphere.

For extending and retracting the sleeve 31, and thereby the inner valve member 46, the nozzle has a reversible electric motor 60 for driving the sleeve linearly into and out of the mould cavity 13. The motor 60 and integral gear box is bolted to a flange 61 of the body member 27 using an adaptor plate 62. The output shaft 63 of the gear box drives nut 64 via clutch 66. The nut 64 rotates within the body member and is supported by bearing assembly 67. A spindle 68 is in threaded connection with the nut 64 at one end, and is connected to the inner end of the sleeve 31 at the other end. The inner end of the sleeve 31 engages a socket 79 in the spindle 68 and is held captive by lock nut 69. A copper sealing washer 80 in the socket 79 ensures a sealed gas connection between bore 50 and the sleeve 31. The spindle contains the gas feed bores 50, 51 and houses the spring 54 for withdrawing the inner valve member 46. A barrel portion 70 of the spindle 68 has a longitudinal slot 71 for reception of

a stop pin 74. The pin 74 is generally D-shaped with its flat 77 in surface contact with the base 65 of the slot 71, whereby the spindle 68 is guided for longitudinal movement towards and away from the mould cavity 13 as the nut 64 is rotated first in one direction and then the other direction by the motor 60. The end surfaces 72, 73 of the longitudinal slot 71 act as dead stops when engaged by the stop pin 74 which define the forward (extended) and backward (retracted) end positions respectively of the sleeve 31.

The electric motor 60 has a stall mode actuated by a current limiting device or other means, e.g. limit switches, when the sleeve is either fully extended or fully retracted so that the motor is not continuously driving the nut 64. Thereby, with the sleeve 31 extended, the load of any pressure on the outer end of the sleeve, tending to retract the sleeve into the nozzle, is directed down the axis of the stationary spindle 68 and nut 64 onto the bearing assembly 67 and not onto the motor 60 or its gear box.

In operation, at the start of the moulding cycle the gas feed pipe 53 is attached to the nozzle 26 by screwing the connector 78 into bore 51. With the gas feed pipe 53 compressed into the channel 32, the nozzle 26 is projected through the bracket 76 into the counterbore 29 in the lower part 12 of the mould to position its inner end at the gas opening 44. The nozzle 26 is then attached to the bracket 76 by the nut 81 engaging the screw thread 28 thereby mounting the nozzle in the mould. In this embodiment, when the nozzle is fully inserted, the end of the extension member 30 is approximately level with the wall surface of the mould cavity 13. The electric motor 60 is actuated to drive the sleeve 31 forward into its extended position so that the sleeve 31 with the inner valve member projects into the mould cavity,

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approximately half-way relative to the thickness of the rib 16. The valve head 47 of the inner valve member 46 is held positively on the valve seat 52 by the spring 54 so that the valve port 45 at the gas opening 44 is closed (Figure 5). With the sleeve in its extended position, the current to the motor 60 is tripped whereby the motor enters its stall mode 8 so that the motor is not continuously operated. The sleeve is thereby temporarily locked in its extended position so that the load of any longitudinal pressure on the sleeve tending to retract the sleeve is directed down the axis of the stationary spindle 68 and nut 64 onto the bearing assembly 67, and not onto the motor or the gear box. The screw ram 18 contains molten plastic material and the slide valve 21 is open. The chamber 35 is also filled with pressurized gas and both valves 36 and 38 are closed.

Operation of the screw ram 18 introduces the plastics material 19 into the mould cavity 13 through the opening 43 via the hot runner manifold 17. In this embodiment, the amount of plastics material introduced is less than sufficient to fill the mould cavity 13. Simultaneously, a gas delay timer is started. At the end of this delay time, the outlet end of the sleeve 31 of nozzle 26 is covered by plastics material, but the inner valve member 46 is still withdrawn in its valve port closed position preventing the ingress of plastics material past the valve head 47 (Figure 6). Valve 36 is then opened to supply gas and the piston and cylinder 33, 34 is operated to introduce gas into the mould cavity through nozzle 26. The pressurized gas is fed through pipe 53 and bores 51, 50 to move the inner valve member 46 into the extended or valve port open position (Figure 7) in which the valve head 47 is lifted off the valve seat 52 against the pressure of the spring 54. The gas then flows into the plastics

material within the mould cavity to create a gas containing cavity 25 in the plastics material. The pressurization in the gas is maintained by the piston and cylinder 33,34 whereby the gas in the plastics material causes the plastics material to flow throughout the mould cavity 13 with the gas containing cavity 25 within the plastics material, the cavity 25 thereby extending with the plastics material until the plastics material has extended over the whole of the mould cavity. The gas flow pressure to the cavity 25 is maintained to hold the plastics material in the mould cavity positively against the mould surface as the plastics material solidifies and cools until the moulding can itself sustain the form dictated by the mould surface.

The valve 36 is opened to vent whereby the gas pressure behind the valve head 47 drops and the piston 33 is withdrawn. Opening valve 38 enables the cylinder 34 to be refilled with another quantity of gas under pressure.

As the gas pressure in the nozzle 26 has fallen, the inner valve member 46 is retracted by the spring 54 into its valve port closed position, the valve head 47 being withdrawn to rest positively against the valve seat 52. The motor 60 is actuated in reverse to fully retract the sleeve into its retracted position, whereupon the motor enters its stall mode. The end of the sleeve is then positioned out of the mould cavity and the rebate 55 becomes in communication with the gap 56 between the sleeve 31 and the extension member 30. Consequently the gas in the cavity 25 is vented through the gap 56, hole 57 and groove 58 to atmosphere (Figure 8), thereby relieving the gas pressure in the cavity 25. The mould is then opened and the moulding removed.

The motor is actuated to extend the sleeve 31 to its forward end position and the motor enters its

stall mode, to await the introduction of plastics material during the next moulding cycle.

The invention is not restricted to the specific details of the embodiment described above. For
5 example, the nozzle 26 may be mounted in a different manner in the lower part 12 of the mould. The counterbore 29 may have an internal thread so that the nozzle is screw mounted directly into the mould by
10 employing the thread 28 on the nozzle, whilst the gas feed pipe 53 is compressed into channel 32.

In another embodiment, as shown in Figure 9, the flange 61 of the body member 27 is of larger diameter than the adaptor plate 62, and the body member is
15 attached to the lower part 12 of the mould by three bolts 82 (one being shown) passing through the flange 61 directly into the lower part of the mould. In this case the thread 28 on the body member 27 is omitted.

Indeed, it will be appreciated that the counterbore 29 in the lower part 12 of the mould
20 and/or any attachment bracket 76 may be adapted to allow the same nozzle 26 to be mounted in moulds of different dimensions so that the nozzle still projects sufficiently through one mould part and is aligned with the gas opening 44. Alternatively, the nozzle
25 illustrated could be modified by attachment of a different length extension member 30, together with an appropriate length sleeve 31 and inner valve member 46. For example, for a deeper lower mould part 12, a longer extension member 30, sleeve 31 and valve member
30 46 would be provided, whilst for a narrower lower mould part 12, the length of the extension member, sleeve and valve member would be correspondingly shorter.

Also the opening 44 can be directly in the mould
35 cavity 13, as illustrated, or in communication therewith.

Furthermore, a nozzle of the kind described may

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be provided at a different position than the position
illustrated or at more than one position in the mould,
in the same manner as described in relation to the
embodiments of Figures 4 to 9 of British Patent
5 Specification No.2202181. Similarly, as described in
the same prior specification, two or more openings 43
may be provided through which the molten plastics
material enters the mould cavity 13.

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CLAIMS:

1. A nozzle for supplying/relieving pressurized
5 gas in gas assisted injection moulding of plastics
material, the nozzle comprising:

a body member adapted to be mounted in a mould
having a mould cavity, a portion of the body member or
an extension thereof extending into an opening in the
10 mould which at least communicates with the mould
cavity;

a sleeve member mounted for sliding movement in a
bore in the extending portion of the body member
between an extended position in which one end of the
15 sleeve projects beyond the extending portion of the
body member into the mould cavity, and a retracted
position;

said one end of the sleeve defining a valve port
for an inner valve member axially movable within the
20 sleeve for opening and closing the valve port,

attachment means for supplying pressurized gas to
the inside of the sleeve whereby the inner valve
member is movable into a valve port open position by
the pressurized gas;

25 means for moving the inner valve member into a
valve port closed position;

means for moving the sleeve between its extended
and its retracted positions, and

a gap between the adjacent wall of the sleeve and
30 the extending portion of the body member, which gap is
closed to the mould cavity when the sleeve member is
extended and open to the mould cavity when the sleeve
member is retracted, whereby in the retracted position
of the sleeve, the pressurized gas within the mould
35 cavity can vent to atmosphere.

2. A nozzle as claimed in Claim 1, wherein
means for moving the sleeve between its extended and

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retracted positions is a reversible electric motor, the sleeve being connected to the motor by means which enable the sleeve to move linearly.

5 3. A nozzle as claimed in Claim 2, wherein when the sleeve reaches its extended position, the motor enters a stall mode.

10 4. A nozzle as claimed in Claim 2 or Claim 3, wherein with the sleeve in its extended position, pressure on the sleeve is isolated from the motor and its gear box.

15 5. A nozzle as claimed in any one of Claims 2 to 4, wherein the connection means between the sleeve and the motor is a nut and spindle in driving relation, the nut being driven by the motor and the spindle being connected to the sleeve.

20 6. A nozzle as claimed in any one of the preceding claims, wherein the body member has an external thread for mounting the nozzle in a mould part or a bracket fixed thereon.

25 7. A nozzle as claimed in any one of Claims 1 to 5, wherein the body member is bolted to a mould part.

30 8. A nozzle as claimed in any one of the preceding claims, wherein the wall of the sleeve is tapered inwardly from the outer end of the sleeve to define a lead-in to the valve seat of the valve port.

35 9. A nozzle as claimed in any one of the preceding claims, wherein the means for moving the inner valve member into a valve port closed position is a spring.

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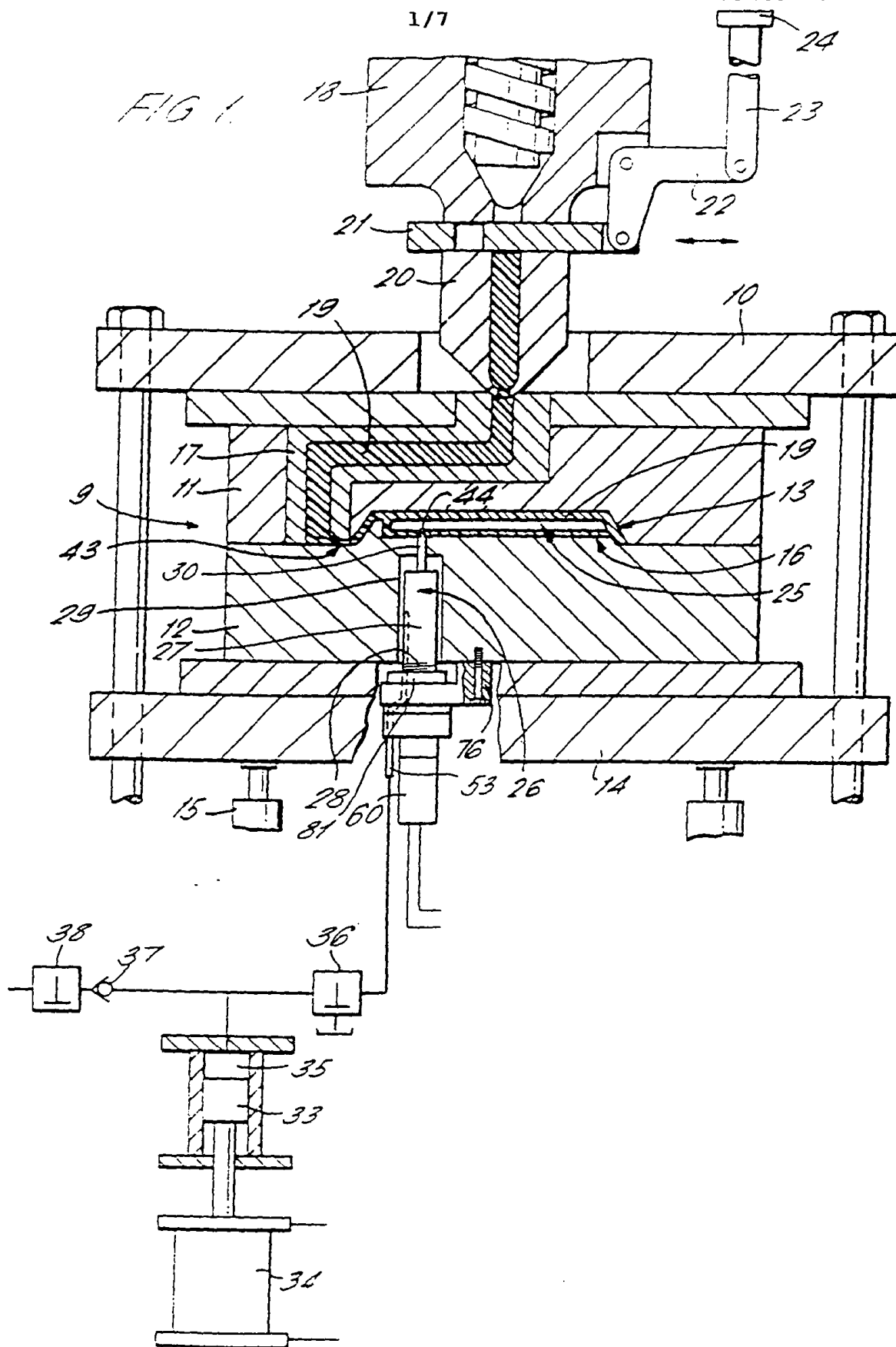
10. A nozzle as claimed in any one of the preceding claims, wherein the inner valve member is a sliding fit within the sleeve, and has at least one flat extending longitudinally of the valve member to
5 create a passage for pressurized gas through the sleeve when the inner valve member is extended by the pressure of the gas.

11. A nozzle as claimed in any one of the preceding claims, wherein the outer end of the sleeve
10 is of reduced external dimension relative to the internal dimension of the extending portion of the body member, and wherein the body member has at least one groove extending longitudinally from a position at
15 one end where it can communicate with the reduced end portion of the sleeve when the sleeve is in its retracted position, but is precluded from said communication when the sleeve is in its extended position, to an open position at its other end where
20 it communicates directly or indirectly with the atmosphere.

12. Apparatus for gas-assisted injection moulding including a nozzle as claimed in any one of
25 the preceding claims.

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FIG 1



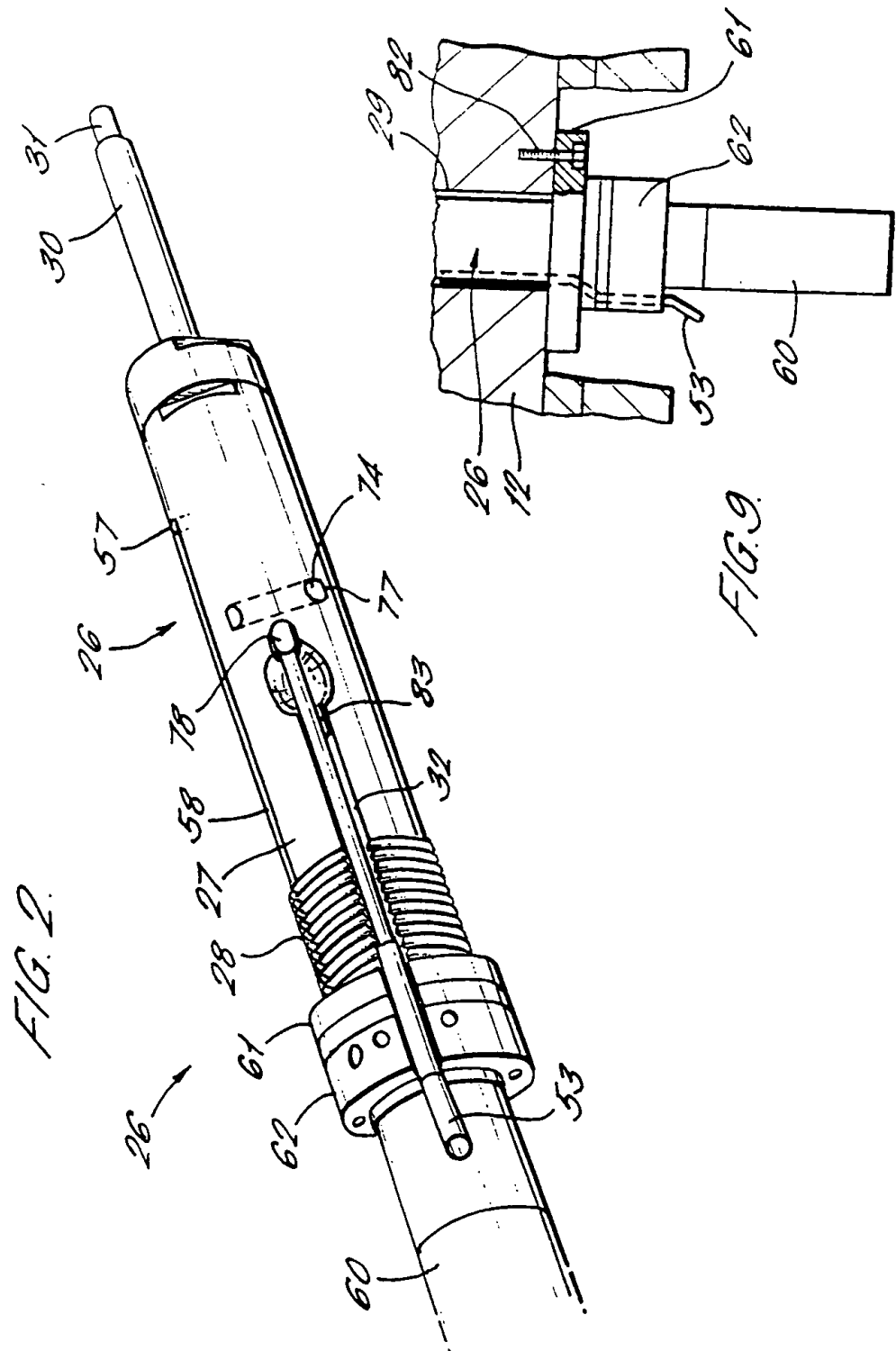


FIG. 3.

